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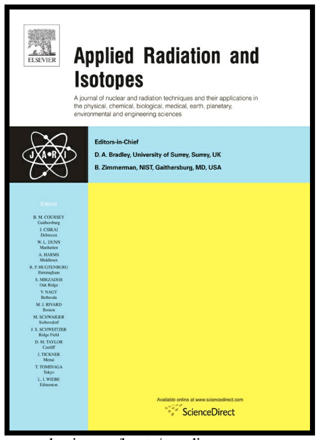

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Dynamic Material Decomposition Method for MeV Dual-Energy X-ray CT

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Abstract

A decomposition model with an iterative solving framework is proposed for use in MeV dual energy computed tomography (DECT). The decomposition model can deal with a broad range of materials and better matches the physics of MeV photons. The proposed iterative solving framework is based on the conventional projection-domain decomposition method, and verified by numerical experiments and experiments. It is shown that images reconstructed with the proposed method have less artifacts and provide more accurate estimates of the atomic number of materials than the conventional projection-domain decomposition method.

***Index Terms*—Tomography; CT; Dual Energy; Material Decomposition; MeV.**

1. Introduction

Mega electron-volt (MeV) dual-energy digital radiography (DEDR) is applied in cargo and large container to detect explosives, contraband and nuclear materials (Ogorodnikov S. and Petrunin V., 2002; Chen G. Y. et al., 2005; Budner G. J., 2006; Chen G. Y. et al., 2007; Katz J. I. et al., 2007 ; Uhlmann, N. et al., 2014.). However, DEDR's material discrimination ability is limited, especially when there are more than one material along the x-ray path (Chen G. Y. et al., 2007; Li L. et al., 2016). Computed tomography (CT) overcomes this problem. A prototype MeV CT was developed for inspecting automotive vehicles and sea-freight containers (Uhlmann, N. et al., 2014). Dual-energy CT (DECT) takes advantages of photon energy to provide material information, and is used in medical imaging with x-rays in the 100-kev range (Engler P. et al. 1990; Thomas G. F. et al. 2006; Simone M. et al. 2009; Bernhard K. et al. 2011; Li L. et al. 2015). In the MeV range, a prototype for air-freight cargo inspection was introduced and tested with common materials such as iron, salt and sugar (Xing, Y. et al., 2011).